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Project

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Author Fred B. Knight

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ENGELMANN SPRUCE BEETLE CONDITIONS
ROUTT, ARAPAHO, and WHITE RIVER NATIONAL FORESTS, COLORADO
1953

Fort Collins, Colorado

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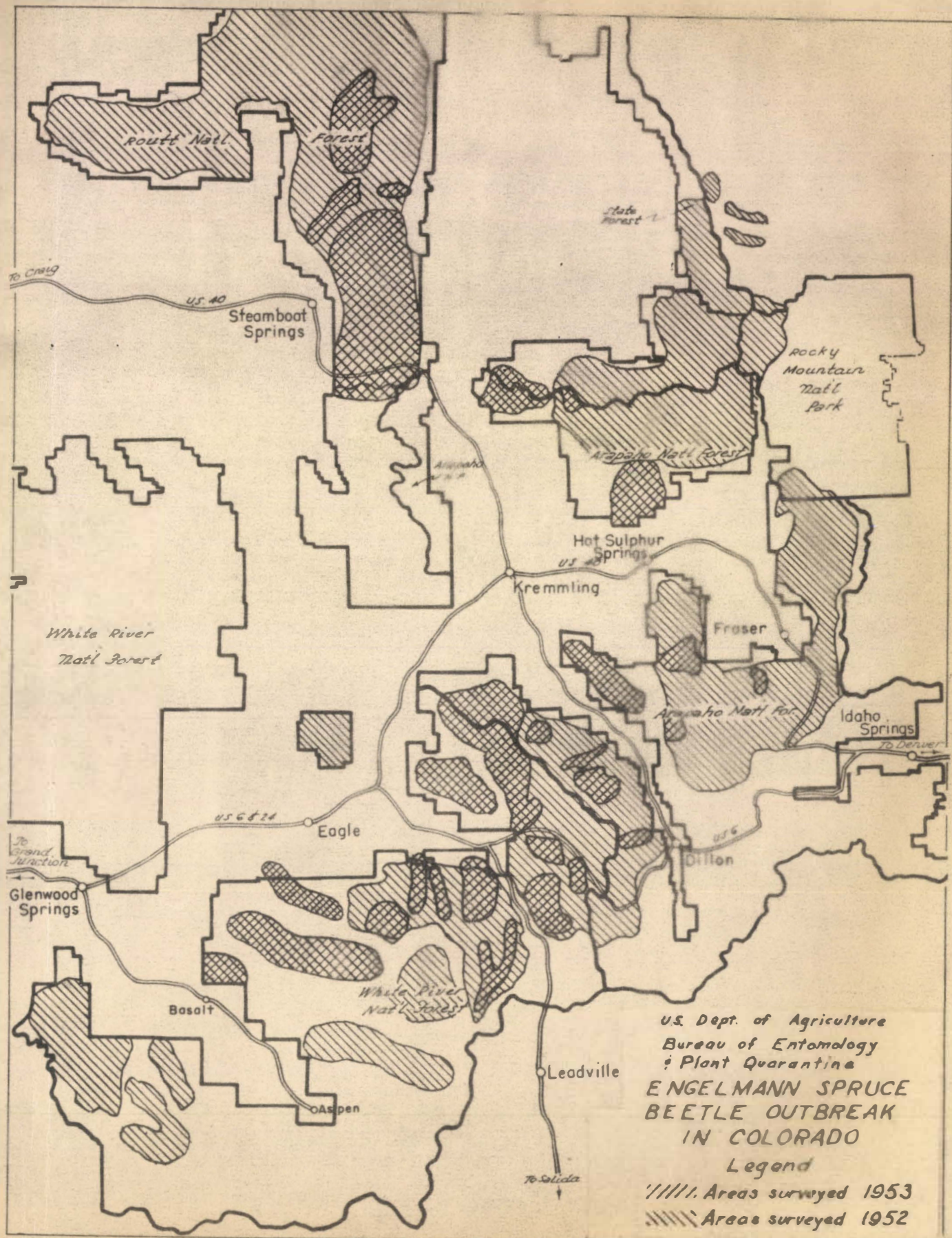
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Table of Contents

	<u>Page</u>
MAP OF 1953 SURVEY COVERAGE	
INTRODUCTION	1
History of the Present Outbreak	1
The Control Program--1949 Through 1952	1
THE 1953 SURVEYS	2
The Survey in General	2
Table 1	3
Survey Personnel	3
Table 2	3
Areas Covered--White River National Forest	4
Areas Covered--Arapaho National Forest	6
Areas Covered--Routt National Forest	6
Survey Plans--1954	7
Table 3	7
THE 1953 CONTROL PROJECT	7
Kremmling Area	7
Eagle Area	8
THE 1954 CONTROL PROJECT	8
SUMMARY	8
REFERENCES	8



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ENGELMANN SPRUCE BEETLE CONDITIONS
ROUTT, ARAPAHO, and WHITE RIVER NATIONAL FORESTS
Colorado 1953

Appraisal Survey

Introduction

History of the Present Outbreak

The epidemic outbreak of Engelmann spruce beetle (*Dendroctonus engelmanni* Hopk.) on the White River, Routt, and Arapaho National Forests developed following a severe spruce blowdown on June 20, 1939 on the White River and Grand Mesa National Forests. Beetle populations from the down spruce commenced attacking green standing spruce in 1941. By 1943 the destruction was widespread, not only on the White River and Grand Mesa Forests but also on the Gunnison, Uncompahgre, and San Juan National Forests.

By 1945 the infestations on the Uncompahgre, San Juan, and Gunnison National Forests had subsided. Heavy infestations moved north and east into the spruce stands on the Routt and Arapaho National Forests during 1944, 1945, and 1946. The outbreak on the Grand Mesa was reduced to an endemic level in 1947 due largely to sanitation logging.

By 1948 most of the merchantable spruce on the White River National Forest north of the Colorado River had been killed. The general northeasterly movement of the outbreak was interrupted in 1949 when strong winds from the northwest during the flight period carried the attacking beetles south of the Colorado River into areas on the White River and Arapaho National Forests, thus far relatively free of infestations. By 1952 the losses were over 4.3 billion board-feet of Engelmann spruce and lodgepole pine. The losses during 1953 were comparatively light. Total losses remain between 4.3 and 4.4 billion board-feet of timber.

The Control Program--1949 Through 1952

In the fall of 1949 a pilot control operation was set up in the heavy outbreak area of Basalt Mountain to test treating methods and obtain operational "know-how". This operation was followed by the successful control project of 1950 when 784,082 spruce trees were treated. The estimate for continued work in 1951 was 1,546,600 trees.

Temperatures lethal to the spruce beetle occurred during the winter of 1950-51 throughout the outbreak area. Winter surveys showed an average beetle mortality of 87 percent above the snow line. The woodpecker population having increased tremendously was forced by this beetle mortality in the upper stems to intensify its feeding in the lower part of the boles as the snow receded. Spring surveys revealed that as a result of this "freeze" and feeding many areas were eliminated from the need of chemical control. Consequently, the delayed control project in 1951 successfully combated the beetle population where winter mortality had been variable or low; 199,002 trees were treated.

The fall survey in 1951 indicated that an estimated 400,000 beetle-infested trees would need to be treated in 1952. It was realized and expected that this figure might be decreased by increased woodpecker activity and increasing parasitism. A very successful project was carried out in 1952 and only 227,859 trees and trap logs were treated. This project included all areas where the insects were at serious epidemic levels; many scattered infested trees remained for the "mop-up" campaign.

(A small number of trap logs was cut in several areas during the fall of 1951. These were successful in attracting beetles and prevented successful attacks on standing trees in the surrounding spruce. Trap logs will continue to be used in the "mop-up" phase of the control program.)

The survey and scouting program in 1952 was coordinated closely with the control program and all known serious epidemics were treated. Based on the untreated scattered attacks an estimate of 25,000 trees was made for the 1953 control project. No large number of trap logs was cut; green trees had been pushed over along the new roads on Red Table Mountain where traps were most needed. The pushed-over trees served as traps to absorb some of the 1953 flight. A small group of trap logs was cut on the Routt National Forest.

The 1953 Surveys

The Survey in General

The field survey of 1953-attacked spruce began in mid-July and terminated on August 26. The survey was mainly by scouting although several systematic surveys were made in "hot-spots" found through scouting; one hundred percent coverage was made in several instances. Scouting was done in all known areas where scattered attacked trees or groups of trees had not been treated in 1952 and in all areas treated in 1952.

The objective was to find all epidemic areas so they could be treated during 1953. It was realized that scouting crews would find many scattered trees; control treating of these, however, would not be feasible. When the control operations terminated, all known "hot-spots" had been treated. Many scattered 1952-attacks containing few beetles remain. Trap logs have been cut on Red Table Mountain, and in the Sheephorn-Elliott Creek area where the 1952 attacks were most numerous. These traps should absorb most of the 1954 flight from those trees. Since many scattered 1953-attacked trees exist, it is expected that more trap trees will need to be felled before the 1955 flight.

Scouting was essentially a task of examining at random susceptible stands of spruce, counting and plotting on maps all infested trees on the scouting lines, and determining from the collected data whether or not epidemics existed. If an epidemic area exceeded 10 acres in size, it was to be surveyed by the line plot system; if it was under 10 acres all trees were to be inspected. The 1953 scouting revealed no new epidemic areas.

Surveying was the collection of data from 1/10-acre circular plots established on parallel lines across each epidemic area over 10 acres in size. Areas that were 10 acres or smaller were cruised 100 percent. The intensity of survey coverage during 1953 was as shown in Table 1.

Table 1.--Intensity of survey coverage

Size of area in acres	Percent survey	Distance between plots in chains	Distance between lines in chains
1 to 10	100	---	---
10 to 500	5 or 10	2	10 or 5
500+	2.50	2	20

The data tallied for each 1/10-acre plot was:

1. Number of 1953 full-attacked trees.
2. Number of 1953 partial-attacked trees.
3. Number of 1952 full-attacked trees.
4. Number of trees attacked in 1952 with additional attacks in 1953.
5. Timber type.
6. Degree of woodpecker feeding.
7. The number of green spruce (taken on every fifth plot).
8. Remarks on severity of beetle attacks, topography, etc.

The following definitions of attack were used:

1. "Full attack"--tree infested for over 50 percent of its circumference by 1953-attacking beetles.
2. "Partial attack"--tree infested in less than 50 percent of its circumference by 1953-attacking beetles.

Survey Personnel

Fewer survey personnel were used during 1953 than in the previous years of the control project. The 1953 listing is shown in Table 2.

Table 2.--Engelmann spruce beetle survey personnel, White River, Arapaho, and Routt National Forests, 1953

Name	Position
B. H. Wilford ^{1/}	Entomologist in Charge, Project
F. B. Knight ^{1/}	Training, Field Administration
F. M. Yasinski ^{1/}	In Charge, Field Operations

^{1/} Permanent employees, U. S. Department of Agriculture, Bureau of Entomology and Plant Quarantine, Forest Insect Laboratory, Fort Collins, Colorado.

Table 2.--Continued

Name	Position
✓ J. A. E. Knopf	Chief of Survey Party
W. L. Eichenberger	" " " "
I. E. Lindauer ^{2/}	" " " "
R. L. Barger	" " " "
W. E. Taylor ^{2/3/}	" " " "
✓ J. D. Caldwell ^{3/}	" " " "
R. M. Munger	Survey Crew Member
A. E. Lund, Jr.	" " "
W. B. Tavener	" " "
T. A. Shalla	" " "
G. G. Morris ^{2/}	" " "
D. W. Sass	" " "
C. W. Bussert	" " "
C. W. Clifton	" " "
✓ P. Brock	" " "

^{2/} Was not on this project through the entire period.

^{3/} Was a survey crew member for a portion of the period.

The excellent work done by all seasonal employees as a team and as cooperators with the U. S. Forest Service is appreciated by the permanent staff of the laboratory. Without the constant and determined attention of F. M. Yasinski in directing the field work of the crews the survey would not have been completed without hurting other programs of the laboratory.

Areas Surveyed--White River National Forest

Several areas which formerly had contained large numbers of beetles were scouted. In all areas except Red Table Mountain the spruce beetle was at an endemic level. Many of these areas will need no further attention. Some areas where small groups of infested trees were found will be scouted during 1954.

Red Table Mountain, as expected, was a problem area again in 1953. A thorough system of scouting was carried out over the entire spruce type. One hundred percent surveys of small "hot-spots" were made in several blocks. The tallies were confined mostly to the 1953-attacks since all of the 1952-attacks contained very few beetles. Green spruce pushed over during road building in 1952 contained large numbers of beetles. It was recommended that all of these trees be treated. Concentrations of 1953-attacked trees were found in the following locations:

1. Down spruce along new roads.
2. East of the head of Red Creek on top of the mountain.
3. Red Creek drainage.
4. Vicinity of Corral Camp, north of road, and east of camp.
5. Taylor Creek drainage.

6. Otto Creek drainage.
7. Cattle Creek drainage.
8. Antones Cabin Creek drainage.
9. Leeman Creek drainage.
10. North of Iola Creek and road to Sundell Creek.

Control work was recommended only for some areas where groups were found. In other areas the groups were small and inaccessible, and woodpeckers were numerous and very active; still others the woodpeckers and parasites had completely eliminated all beetles from 1952-attacked trees. Control was recommended in all the large "hot-spots", especially where natural control factors had not been or apparently would not be very effective. In addition to the groups of "hot-spots", scattered attacked trees were found in practically all of the spruce type.

In all other areas on the White River National Forest endemic situations were found. Small groups of new attacks were found as follows:

1. Piney - 3 groups, 23, 6, and 10 trees, respectively.
2. Head of Middle Creek, 6 trees.
3. Head of Soda Creek, 40 to 60 trees.
4. Head of East Meadow Creek, 40 to 60 trees.
5. Head of West Grouse Creek, 9 trees.
6. South of Mount Eve, 3 small groups 6 to 10 trees in each.

Woodpecker work was heavy to extreme in all of these areas; no control was recommended, but all the areas should be examined in 1954.

The following areas were scouted. Some contained a few scattered newly-attacked trees but all were endemic.

1. Spraddle Creek.
2. Mill Creek.
3. Middle Creek.
4. Piney Lake.
5. Red Sandstone Creek.
6. Grouse Creek and Grouse Lake.
7. Beaver Creek and Beaver Lake.
8. Timber Creek.
9. Stone Creek.
10. Hardscrabble Mountain.
11. Willow Creek.
12. Lime Creek.
13. Two Elk Creek.
14. Homestake Creek.
15. Hornsilver Mountain.
16. Basalt Mountain.
17. Henderson Park.
18. Barida Cabins.
19. Yeoman Park.
20. East Lake Creek.
21. East Brush Creek.

Areas Surveyed--Arapaho National Forest

One problem area remained on the Arapaho National Forest during 1953. In addition many areas which formerly contained epidemic numbers of killed trees were scouted. In general, endemic situations were found.

The Sheephorn-Elliot Ridge area contained several "hot-spots" where systematic surveys were made and treatment was recommended. The most serious were along Three Licks Creek where several hundred trees were found. Additional "hot-spots" were found on Elliot Ridge, along Deep Creek, along Martin Creek, and at the head of Elliot Creek. The "hot-spots" at the head of Elliot Creek were numerous. Woodpecker work had been very effective in most of the area. Parasite activity appeared to be on the increase.

Small groups of newly attacked trees were found in other locations where the infestations probably will be eliminated by natural control factors. These areas are:

1. Surprise Lake.
2. Williams Ridge, Head of Mule and Lost Creeks.

Areas which contained no groups but occasional scattered trees are:

1. South Willow Creek.
2. Boulder Creek and Boulder Lake.
3. Rickey Creek.
4. Simpson Creek.
5. Upson Creek.
6. North Rock Creek.
7. Pebble Creek.
8. Keyser Creek.
9. Slate Creek and Slate Lake.
10. Chimney Rock.
11. Elk Mountain.
12. Fool Creek.

Areas Surveyed--Routt National Forest

The spruce type from Buffalo Park on the south to Seedhouse Station on the north was scouted. Many scattered attacks were found; no treatable 1952-attacked trees were seen, but one "hot-spot" of new attacks was located.

This "hot-spot" is along Walton Creek about 2 miles west of Fishhook Lake. It is expected that the beetles in these 1953-attacked trees will be eliminated by natural control factors. This area will be watched closely during 1954.

No treating of standing trees was recommended for the Routt National Forest for 1953. About 100 attacked trap logs were treated as a part of the Arapaho treating project.

Survey Plans--1954

A sizeable survey project is planned for 1954 although many areas scouted during 1953 will not be checked unless increases are detected by the land managers. As in previous years, all areas where attacks are found and reported by the rangers will be examined. The projected survey plan for 1954 is shown in Table 3.

Table 3.--Survey plan for 1954, White River, Arapaho, and Routt National Forests

Forest	Area	Estimated man days	Remarks
White River	Piney	3 to 6	Scout N.E. of Piney #2 camp
	Rod Table	90 to 120	Scout and survey
	Middle Creek	1	Scout drainage
	Meadow Creek	2 to 4	Scout Soda and East Meadow Creeks
	West Grouse Creek	1	Scout drainage
	Mount Eve	2	Scout south of mountain
Arapaho	Sheephorn	3 to 6	Scout and survey
	Elliot Creek	3 to 6	" " "
	Surprise Lake	1	Scout, general
	Williams Ridge	2	Scout Lost and Mule Creeks
	Fool Creek	1	Scout drainage
Routt	Rabbit Ears to Buffalo Pass	10 to 15	Scout, general

The total time required for surveying will be in the neighborhood of 150 man days plus the additional time needed to survey areas detected by the land-managing agency and the time needed for training. It is estimated that 6 to 8 seasonal employees will be used for a period of 6 to 7 weeks commencing late in July.

The entire Red Table Mountain area will not be surveyed. The area west of Red Creek on the north side of the mountain will no longer be checked due to the small amount of green spruce left. In the Piney area only those blocks where some infestation was found in 1953 will be checked.

The 1953 Control Project

Kremmling Area

Prior to July 1, 1953 the trap logs which were attacked during 1952 were chemically treated. These included traps in the Sheephorn-Elliot Creek area and on Williams Ridge. The total number treated was 2,113 logs.

Several "hot-spots" found during the 1953 surveys were treated during the summer; 1,668 standing trees and 700 stumps in all. Traps were cut to absorb some of the beetles during the 1954 flight in the Sheephorn, Elliot Creek, and Meadow Creek areas. The total number of green trees cut for traps was 134.

Eagle Area

On Red Table Mountain 10,047 trees were treated during the summer. These were in small "hot-spots" at many points on the mountain and in down green spruce along the roads. Many of the treated trees were 1952-attacks. A total of 695 green trees was cut on Red Table Mountain for traps.

The 1954 Control Project

Based on a probable limited number of heavily infested trees a small treating project will be needed during 1954. The maximum number expected is 1,000 trees on the Arapaho and 5,000 on the White River, including the traps.

It may be necessary to cut trap logs in three areas to absorb part of the 1955 flight. These areas are: Red Table Mountain, Sheephorn-Elliot Creek, and Walton Creek.

Summary

The 1953 surveys on the White River, Arapaho, and Routt National Forests showed an endemic situation over most of the old outbreak areas of the Colorado spruce beetle infestation. Exceptions were in the Sheephorn-Elliot Creek area and on Red Table Mountain where 2,368 and 10,047 trees and stumps were treated, respectively. In these two areas 829 trap logs were cut to absorb a portion of the 1954 flight.

The proposed 1954 survey will require 6 to 8 seasonal employees for 6 or 7 weeks. Many areas surveyed in 1953 will not be visited unless epidemic conditions develop. The most serious problem area is Red Table Mountain. This area will be closely checked.

The control project in 1954 may be such that a maximum of 6,000 trees will need to be chemically treated. This includes the 829 trees felled this fall as traps. More trap logs probably will be cut in the fall of 1954 to absorb a portion of the 1955 flight.

References

- (1) WYGANT, N. D.
October 31, 1944. ENGELMANN SPRUCE BEETLE OUTBREAK IN WESTERN COLORADO. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.

- (2) WYGANT, N. D.
October 20, 1942. EXAMINATION OF INSECT CONDITIONS ON THE WHITE RIVER NATIONAL FOREST. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (3) _____
October 23, 1943. MEMORANDUM ON ENGELMANN SPRUCE BEETLE INFESTATIONS, WHITE RIVER NATIONAL FOREST. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (4) STRUBLE, G. R.
December 20, 1944. THE ENGELMANN SPRUCE BEETLE--A PROGRESS REPORT OF 1944 STUDIES ON THE GRAND MESA NATIONAL FOREST, COLORADO. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (5) MASSEY, C. L.
March 12, 1945. ENGELMANN SPRUCE BEETLE STUDIES, SEASON OF 1944, WHITE RIVER NATIONAL FOREST. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (6) TERRELL, T. T.
October 4, 1944. LOSSES CAUSED BY ENGELMANN SPRUCE BEETLE, WHITE RIVER NATIONAL FOREST, 1940-1944. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (7) _____
October 23, 1944. ENGELMANN SPRUCE BEETLE AND BLACK HILLS BEETLE INFESTATIONS ON THE HOLY CROSS NATIONAL FOREST, SEPTEMBER 1944. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (8) _____
October 30, 1944. INSECT INFESTATIONS, ROUTT NATIONAL FOREST, ENGELMANN SPRUCE BEETLE--BLACK HILLS BEETLE, OCTOBER 1944. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (9) _____
January 27, 1945. ENGELMANN SPRUCE BEETLE INFESTATION, WHITE RIVER NATIONAL FOREST, 1944. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (10) _____
June 27, 1946. INFESTATIONS OF THE ENGELMANN SPRUCE BEETLE IN WESTERN COLORADO. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.

- (11) TERRELL, T. T.
October 22, 1945. PRELIMINARY REPORT OF INSECT INFESTATIONS ON AREAS IN REGION 2, SURVEYED JULY 2 TO OCTOBER 9, 1945. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (12) _____
April 16, 1945. ENGELMANN SPRUCE BEETLE INFESTATIONS ON THE NATIONAL FORESTS OF THE WESTERN SLOPE OF COLORADO, 1946. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (13) GINTER, P. L.
ENGELMANN SPRUCE BEETLE INFESTATION ON THE NATIONAL FORESTS OF THE WESTERN SLOPE OF COLORADO, 1947. Unpublished report. U.S.D.A. Forest Service, Denver, Colorado.
- (14) McCAMBRIDGE, W. F.
February 11, 1949. ENGELMANN SPRUCE BEETLE INFESTATIONS ON THE NATIONAL FORESTS OF THE WESTERN SLOPE OF COLORADO, 1948. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (15) _____, and MERKEL, E. P.
November 15, 1949. ENGELMANN SPRUCE BEETLE OUTBREAK ON THE NATIONAL FORESTS OF THE WESTERN SLOPE OF COLORADO. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (16) McCAMBRIDGE, W. F.
May 1950. ANALYSIS OF THE ENGELMANN SPRUCE BEETLE SURVEY OF 1949 WITH REFERENCE TO CONTROL. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (17) _____
November 15, 1950. ENGELMANN SPRUCE BEETLE OUTBREAK ON THE NATIONAL FORESTS OF THE WESTERN SLOPE OF COLORADO, 1950. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (18) _____
July 23, 1951. ENGELMANN SPRUCE BEETLE MORTALITY DUE TO COLD TEMPERATURES AND WOODPECKER FEEDING, 1951. Unpublished memorandum. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (19) _____
December 7, 1951. ENGELMANN SPRUCE BEETLE SURVEY, ROUTT, ARAPAHO, AND WHITE RIVER NATIONAL FORESTS, COLORADO, 1951. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (20) MASSEY, C. L.
TRAP LOG STUDIES, ROUTT NATIONAL FOREST, 1949. Unpublished report on Line Project I-c-1-8. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.

- (21) 1950. ENGELMANN SPRUCE BARK BEETLE CONTROL PROJECT, COLORADO, 1950. Unpublished report. U.S.D.A. Forest Service and Bureau of Entomology and Plant Quarantine, Denver, Colorado.
- (22) 1951. ENGELMANN SPRUCE BARK BEETLE CONTROL PROJECT, COLORADO, 1951. Unpublished report. U.S.D.A. Forest Service and Bureau of Entomology and Plant Quarantine, Denver, Colorado.
- (23) 1951. TO SAVE THE TREES BEYOND, revised October 31, 1951. Unpublished report. U.S.D.A. Forest Service, Denver, Colorado.
- (24) 1952. SAVING THE TREES BEYOND. Unpublished report. U.S.D.A. Forest Service, Denver, Colorado.
- (25) KNIGHT, F. B.
October 3, 1952. ENGELMANN SPRUCE BEETLE CONDITIONS, ROCKY MOUNTAIN NATIONAL PARK, COLORADO, 1952. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (26) .
November 12, 1952. ENGELMANN SPRUCE BEETLE CONDITIONS, ROOSEVELT NATIONAL FOREST, 1952. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (27) .
December 18, 1952. ENGELMANN SPRUCE BEETLE CONDITIONS, ROUTT, ARAPAHO, AND WHITE RIVER NATIONAL FORESTS, COLORADO, 1952. Unpublished report. U.S.D.A. Forest Insect Laboratory, Fort Collins, Colorado.
- (28) 1952. ENGELMANN SPRUCE BARK BEETLE CONTROL PROJECT, COLORADO, 1950-52. Unpublished report. U.S.D.A. Forest Service and Bureau of Entomology and Plant Quarantine, Denver, Colorado.
- (29) CLARK, DONALD E., by A. L. NELSON.
October 30, 1953. LETTER TO CHIEF, U.S.F.S., ESTIMATES FOREST PEST CONTROL.

